

respiratory droplets, HMPV can cause a wide range of symptoms, from mild upper respiratory infections to severe illnesses like bronchiolitis and pneumonia.²

The significance of studying HMPV has grown in the post-COVID-19 era, where it shares clinical similarities with other respiratory viruses like SARS-CoV-2. Often underdiagnosed due to limited routine testing, HMPV presents unique challenges in settings where co-infections and overlapping symptoms complicate diagnosis and treatment. Additionally, changes in population immunity following the pandemic may have altered its epidemiology and severity.³ Understanding HMPV in this new context is vital to improving diagnostics, developing targeted treatments, and shaping public health policies to protect vulnerable populations.

Epidemiology of HMPV:

Seasonal trends and prevalence: Human Metapneumovirus (HMPV) typically exhibits a well-defined seasonal peak, often occurring during the winter months in temperate regions, with some variations in timing influenced by geographical and climatic factors. In tropical areas, HMPV activity may coincide with the rainy season, reflecting regional differences in its epidemiology.⁴

At-risk Populations: Children, Elderly, and Immunocompromised Individuals

Certain groups are particularly vulnerable to severe HMPV infections. Young children, due to developing immune systems and smaller airways, are at high risk of complications like bronchiolitis and pneumonia. The elderly, with age-related immune decline, often face severe respiratory infections and worsened chronic conditions. Immunocompromised individuals, including those with HIV/AIDS or undergoing chemotherapy or transplants, are at heightened risk of respiratory failure and prolonged viral shedding, complicating recovery.^{5,6}

Co-infections with Other Respiratory Viruses

A more complicated clinical picture is produced when HMPV co-occurs with other respiratory viruses, including rhinovirus, influenza, parainfluenza, and Respiratory Syncytial Virus (RSV). Particularly in at-risk groups, co-infections can worsen the severity of the illness, lengthen hospital stays, and raise the chance of admission to critical care. These viruses are difficult to diagnose because of their similar seasonality and overlapping symptoms.⁷

Impact of COVID-19 on HMPV Epidemiology

Disruption of Transmission During COVID-19 COVID-19 measures like mask-wearing, social distancing, school closures, and enhanced hygiene practices significantly reduced HMPV transmission. These interventions minimized person-to-person spread, leading to a dramatic decline in cases and offered insights into controlling respiratory virus outbreaks.⁸

Reduction in HMPV Cases From 2020–2021, HMPV infections sharply declined, as seen in reduced hospitalizations and respiratory cases, mirroring trends in other respiratory viruses. This highlights the impact of behavioral and environmental changes on viral transmission.⁸

Delayed or Atypical Outbreaks Post-Pandemic With eased restrictions, HMPV saw delayed and atypical outbreaks, likely due to decreased population immunity and disrupted seasonal patterns. Young children, in particular, were more vulnerable due to missed early-life exposures.^{9,10}

Changing Clinical Presentation and Severity.

Increased Severity in Certain Populations Due to Delayed Exposure: The pandemic-induced reduction in viral transmission has resulted in delayed exposure to respiratory pathogens, particularly in young children and other previously unexposed populations. This delay has created a larger pool of susceptible individuals, leading to an increased risk of more severe disease when exposed to HMPV after pandemic restrictions were lifted. In children, the lack of early-life exposure to common respiratory viruses has resulted in stronger immune reactions and more severe clinical outcomes. Similarly, older adults and immunocompromised individuals may experience heightened disease severity due to waning immunity and prolonged periods without viral exposure.¹¹

Role of Long COVID in Complicating HMPV Diagnosis

Long COVID symptoms, including chronic fatigue, lingering cough, and respiratory difficulties, significantly complicate the diagnosis of HMPV infections. In individuals with a history of COVID-19, the overlap in clinical features makes it challenging to differentiate between residual effects of COVID-19 and new HMPV infections, potentially delaying appropriate treatment. This diagnostic challenge is particularly concerning for at-risk populations, as the interplay between long COVID and HMPV could worsen respiratory complications. These complexities highlight

the importance of precise diagnostic tools and heightened clinical awareness in managing respiratory illnesses post-pandemic.¹²

Diagnostic Challenges

Compared to the extensive availability of COVID-19 testing, rapid diagnostic tests for HMPV are still rare. Although molecular techniques like PCR are useful, they are frequently unavailable in environments with limited resources, which delays diagnosis and raise the risk of mismanagement. Furthermore, because of its clinical overlap with other well-known respiratory viruses and a lack of knowledge among healthcare professionals, HMPV is commonly under diagnosed. HMPV detection was further obscured during the COVID-19 pandemic by diagnostic efforts that were mostly focused on SARS-CoV-2.¹³

Treatment and Management

Currently, there are no specific antiviral therapies available for Human Metapneumovirus (HMPV), making treatment largely supportive and focused on managing symptoms and preventing complications. Mild cases typically require hydration, fever management, and monitoring, while moderate to severe cases often involve oxygen therapy or mechanical ventilation, with high-flow nasal cannula (HFNC) used to avoid intubation in critical patients. The development of antivirals and vaccines for HMPV is hindered by its genetic diversity, frequent mutations, and limited research. A deeper understanding of its pathogenesis and immune interactions is essential to advance treatment options. Supportive care, including bronchodilators and corticosteroids, plays a crucial role in severe cases, helping to alleviate airway obstruction, reduce inflammation, and minimize complications like respiratory failure, ultimately improving patient outcomes.¹⁴

Preventive Measures

Lessons from COVID-19 (Masking, Hygiene, Vaccination Campaigns): The COVID-19 pandemic has provided valuable lessons in mitigating the spread of respiratory viruses, many of which can be applied to prevent the transmission of HMPV. Public health measures such as mask-wearing, social distancing, and frequent hand hygiene have been proven effective in reducing the transmission of respiratory pathogens, including HMPV. Furthermore, public health campaigns during the pandemic highlighted the importance of respiratory hygiene such as covering coughs and sneezes and avoiding close contact with

symptomatic individuals. These strategies can be incorporated into broader preventive measures to reduce the burden of HMPV, particularly during peak seasons.¹⁵

Potential Role of Surveillance Systems and Vaccination for HMPV

Enhanced surveillance systems for respiratory viruses like HMPV are vital for early detection, outbreak prevention, and guiding public health responses. Post-pandemic, integrating real-time monitoring of seasonal trends, co-infections, and emerging strains could improve vaccination strategies and healthcare practices, reducing morbidity and mortality. Developing vaccines for high-risk groups, including children, the elderly, and immunocompromised individuals, is crucial for achieving herd immunity and mitigating seasonal outbreaks. Tailored vaccine designs addressing HMPV's genetic diversity are essential to ensure broad protection and reduce disease transmission and hospitalizations in vulnerable populations.¹⁶

Public Health Implications

The simultaneous resurgence of HMPV, COVID-19, and influenza poses a serious challenge to healthcare systems, especially during peak respiratory virus seasons. Overcrowded emergency departments, limited ICU beds, and resource shortages like ventilators could make patient care increasingly difficult. To address this, healthcare systems need strong preparedness plans that ensure resources and staff are available when needed. Public health efforts should focus on a comprehensive approach, including wider vaccination campaigns, better diagnostic tools, and clear messaging on prevention measures like hygiene and early detection. Taking a holistic view of respiratory virus management can help ease the strain on healthcare systems.¹⁷

CONCLUSION

The COVID-19 pandemic has reshaped the epidemiology of HMPV, emphasizing the need for a deeper understanding of respiratory virus behavior in a post-pandemic world. Changes in population immunity, diagnostic practices, and seasonal patterns have influenced HMPV transmission, while symptom overlap with COVID-19 complicates clinical diagnosis. Preparedness for future respiratory virus outbreaks, including HMPV, requires strengthened public health

infrastructure, enhanced diagnostic capabilities, and global research investment in vaccines and treatments. Global collaboration is essential to improving surveillance, advancing research, and reducing the burden of HMPV, ensuring a more effective response to future outbreaks and protecting vulnerable populations.

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